
GLOSSARY

Absorption: The process of taking up, of absorbing or of being absorbed.

Accelerated Bioremediation: Bioremediation accelerated beyond the normal actions of the naturally occurring microbial community and chemical and geological conditions, usually by the addition of nutrients or specialized microbes.

Actinide: A radioactive element in the series of elements beginning with actinium (89) and ending with lawrencium (103).

Actinomycetes: A heterogeneous group of gram-positive, generally aerobic bacteria. They have a filamentous and branching growth pattern resulting in an extensive colony, or mycelium. The mycelium in some species may break apart to form rod or coccoid-shaped forms. Many genera also form spores.

Adsorption: The adhesion of molecules (in a thin layer) to the surfaces of solid bodies or liquids with which they are in contact.

Advection: The process by which solutes are transported by the bulk motion of the flowing groundwater.

Aerobic: Living, active, or occurring only in the presence of oxygen.

Algae: Photosynthetic eukaryotic unicellular and simple multicellular microorganisms.

Anabolism: The sequences of enzyme-catalyzed reactions by which molecules are formed in living cells from nutrients; also known as biosynthesis.

Anaerobic: Living, active, or occurring in the absence of free oxygen.

Anion: A negatively charged ion.

Aquifer: Stratum of permeable rock, sand, or gravel that can store and supply groundwater to wells and springs.

Archaea (formerly, archaeobacteria): A group of prokaryotic single-celled microorganisms that constitute the recently recognized Archaea phylogenetic domain. Archaea can be distinguished from bacteria in that their cell walls do not have murein, a peptidoglycan-containing muramic acid. Another unique feature of archaea is the presence of isoprenyl ether lipids in their cell membranes. The Archaea domain includes the methanogens, most extreme halophiles (needing salt for growth), certain sulfate reducers, hyperthermophiles (optimum growth temperature of 80°C or higher), and the genus *Thermoplasma*.

Assimilative Metabolism: The reduction of inorganic compounds for use as a nutrient source.

ATP: Adenosine triphosphate, the principal energy carrier of the cell.

Autotroph: Organism able to utilize carbon dioxide as a sole source of carbon.

Bacteria (formerly, eubacteria; singular bacterium): A group of prokaryotic single-celled microorganisms that constitute the Bacteria phylogenetic domain. Unlike archaea, their cell walls have murein, a peptidoglycan-containing muramic acid. Bacteria may have spherical (coccus), rod-like (bacillus), or curved (vibrio, spirillum, or spirochete) bodies. They inhabit virtually all environments, including soil, water, organic matter, and the bodies of eukaryotes.

Bioaccumulation: Intracellular accumulation of environmental pollutants, such as heavy metals, by living organisms.

Bioaugmentation: The addition of microorganisms to the environment.

Bioavailability: The accessibility of chemical compounds in the environment to an organism or organisms.

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Biodegradation: The breakdown of organic materials into simpler components by microorganisms.

Biomass: The amount of living matter present in a particular habitat.

Bioreactor: Vessel or tank in which whole cells or cell-free enzymes transform raw materials into biochemical products and/or less undesirable byproducts.

Bioremediation: The use of microorganisms to biodegrade or biotransform hazardous organic contaminants or biotransform hazardous inorganic contaminants to environmentally safe levels in soils, subsurface materials, water, sludges, and residues.

Biosequestration: The conversion of a compound through biological processes to a form that is chemically or physically isolated or inert.

Biosorption: Sorption of a molecule by an organism.

Biostimulation: Addition of nutrients, oxygen, or other electron donors and acceptors so as to increase microbial activity and biodegradation.

Biotransformation: Alteration of the structure of a compound by a living organism or enzyme.

Bond: An attractive force that holds together the atoms, ions, or groups of atoms in a molecule or crystal.

Carcinogen: A substance or agent that initiates tumor formation.

Catabolism: The biochemical processes involved in the breakdown of organic or inorganic compounds, usually leading to the production of energy. Important for bioremediation because contaminants are transformed or degraded by microorganisms during catabolism.

Catalyst: A substance that activates a chemical reaction and is not itself changed in the process.

Cation: Positively charged ion.

Cell Membrane: The permeable membrane surrounding the cell's cytoplasm; also called cytoplasmic membrane.

Cell Wall: The layer or structure that lies outside the cell membrane, supporting and protecting the membrane and giving the cell shape.

Chelate: Any of a class of relatively stable coordination compounds consisting of a central metal atom attached to a large molecule, called a ligand, in a cyclic or ring structure.

Chelator: An agent that causes formation of a chelate.

Chemolithotroph: An organism that obtains its energy from the oxidation of inorganic compounds.

Colloid: Microscopic particles suspended in a liquid medium, usually between one nanometer and one micrometer in size.

Cometabolism: Biodegradation of a substance (pollutant) by an organism that uses some other compound for growth and energy.

Commensalism: A one-sided type of symbiosis where organisms from different species live in close proximity to one another, in which the members of one are unaffected by the relationship and the members of the other benefit.

Complex: A type of compound in which a central metal ion is surrounded by a number of ions or molecules, called ligands, that can also exist separately; also known as a coordination compound. A chelate is a type of complex.

Complexing Agent: A dissolved ligand that binds with a simple charged or uncharged molecular species in a liquid solution to form a complex, or coordination compound.

Consortium: A group of organisms that interact within a given environment.

Contaminant: Harmful or hazardous matter introduced into the environment.

Coprecipitation: The incorporation of elements into other compounds, such as metal oxide minerals, as they precipitate from solution.

Covalent Bond: A nonionic chemical bond formed between atoms by the sharing of electrons.

Cytochrome: Protein in the cell membrane that is involved in the transfer of electrons from a substrate to a terminal electron acceptor.

Cytoplasm: Cellular contents inside the cytoplasmic membrane.

Cytoplasmic Membrane: The permeable membrane surrounding the cell's cytoplasm; also called cell membrane.

Denitrification: the formation of gaseous nitrogen (N_2) or nitrogen oxide (NO or N_2O) from nitrate (NO_3^-) or nitrite (NO_2^-) by microorganisms.

Dense Non-Aqueous Phase Liquid (DNAPL): Liquid contaminant that is relatively insoluble and heavier than water.

Deoxyribonucleic Acid (DNA): The molecule that encodes genetic information. DNA is a double-stranded molecule held together by weak bonds between base pairs of nucleotides. The four nucleotides in DNA contain the bases adenine (A), guanine (G), cytosine (C), and thymine (T). In nature, base pairs form only between A and T and between G and C. Therefore, the base sequence of each single strand can be deduced from that of its partner.

Diffusion: The natural tendency of molecules to move out of areas of high concentration into areas of low concentration until a solution or gas has a uniform concentration of the molecules.

Dispersion: The distribution of a solute throughout a solvent, as in sugar in water; the mechanical mixing of solutes that occurs as the solutes are advected through the groundwater system.

Dissimilative Metabolism: The use of an inorganic compound (such as nitrate) as an electron acceptor in energy metabolism; that is, the compound is not used to satisfy nutritional needs.

Electron: A stable atomic particle that has a negative charge.

Electron Acceptor: Small inorganic or organic compound that is reduced in a metabolic redox reaction.

Electron Donor: Small inorganic or organic compound that is oxidized in a metabolic redox reaction.

Element (Chemical Element): Any substance that cannot be decomposed into simpler substances by ordinary chemical processes.

Enzyme: A complex protein that acts as a catalyst in living organisms, regulating the rate at which chemical reactions proceed without itself being altered in the process.

Eukarya: The phylogenic domain consisting of one-celled and multicelled organisms called eukaryotes that maintain their genome within a defined nucleus.

Ex situ: In a position or location other than the natural or original one.

Exergonic Reaction: A chemical reaction that releases energy.

Extremophiles: A group of microorganisms whose growth is dependent on extreme environmental conditions.

Facultative: Used to indicate that an environmental factor is optional. For example, a facultative anaerobe normally grows in the presence of oxygen, but in its absence can grow without oxygen.

Fermentation: Catabolic reaction in which organic compounds serve as both primary electron donor (substrate) and terminal electron acceptor, and in which ATP is produced by substrate-level phosphorylation.

Fission: A nuclear reaction in which an atomic nucleus, especially a heavy nucleus such as an isotope of uranium, splits into fragments, usually two fragments of comparable mass, with the evolution of from 100 million to several hundred million electron volts of energy.

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Functional Group: A characteristic reactive unit of a chemical compound, especially in organic chemistry.

Fungi: Spore-producing eukaryotic organisms that lack chlorophyll; examples of fungi include molds, rusts, mildews, smuts, mushrooms, and yeasts.

Gene: The fundamental unit of heredity consisting of an ordered sequence that codes for a particular polypeptide chain (molecular chain of amino acids) or RNA sequence.

Genetic Engineering: The use of in vitro techniques in the isolation, manipulation, recombination, and expression of DNA, which includes the reintroduction of the affected genes into cells of the same or different species.

Genome: The sum of all chromosomal genes in a cell.

Genotype: All or part of the genetic constitution of an individual or group.

Groundwater: Water found beneath the Earth's surface that fills pores between materials, such as sand, soil, or gravel; supplies wells and springs.

Half-Life: The time required for half of the atoms of a radioactive substance to disintegrate.

Heavy Metals: Metallic elements with high molecular weights. Such metals are often residual in the environment, exhibit biological accumulation, and are generally toxic in low concentrations. Examples include chromium, mercury, and lead.

Heterogeneous: Consisting of diverse or dissimilar constituents.

Heterotroph: An organism that uses an organic source of carbon.

Humic: Relating to humus, which is a material resulting from partial decomposition of plant or animal matter that forms the organic portion of soil.

Hydrocarbons: Any of a large class of organic compounds containing only carbon and hydrogen.

Hydrolysis: The splitting of a bond by a reaction with water, specifically the addition of the hydrogen cation and the hydroxide anion of water.

In situ: In the original position or place.

Inoculant: Material introduced into another medium or environment; in bioremediation, a microorganism. Also inoculum.

Inorganic Compounds: Chemicals that do not contain carbon, which is usually associated with life processes; for example, metals are inorganic.

Insoluble: Incapable of being dissolved in a liquid.

Intrinsic Bioremediation: Bioremediation at a given site as a function of the naturally occurring microbial population and naturally occurring chemical, biological, and geological conditions. Also known as natural attenuation when dominated by biological processes, or natural bioremediation.

Ion: An atom or group of atoms that carries a positive or negative electric charge as a result of having lost or gained one or more electrons; a charged subatomic particle (as a free electron).

Ionic Bond: A chemical bond formed between oppositely charged species because of their mutual electrostatic attraction.

Isotope: Any of two or more species of atoms of a chemical element with the same atomic number (number of protons) and nearly identical chemical behavior but with a different number of neutrons, hence a different atomic weight.

Leaching: The process of separating the soluble components from some material by percolation.

Ligand: A group, ion, or molecule coordinated to a central atom or molecule in a complex.

Light Non-Aqueous Phase Liquid (LNAPL): Liquid contaminant that is relatively insoluble and lighter than water.

Lipid: A diverse group of water-insoluble organic molecules important in the structure of the cell membrane and (in some organisms) the cell wall.

Metabolic Pathway: A sequence of enzymatically catalyzed chemical reactions in cellular metabolism.

Metabolism: All biochemical reactions in a cell, both anabolic and catabolic.

Methanogen: Microorganism that produces methane.

Methanogenesis: Microbial production of methane (CH_4) through the reduction of CO_2 . This reduction is coupled to oxidation of hydrogen, or certain organic compounds.

Methanotroph: Aerobic microorganism that can oxidize methane as a sole source of carbon.

Methylation: Oxidation of methane as a source of carbon by microorganisms known as methanotrophs.

Microbiology: A branch of biology dealing especially with microscopic forms of life (bacteria, archaea, protozoa, algae, viruses, and fungi).

Microorganism: Any organism of microscopic or ultramicroscopic size.

Mineralization: The complete breakdown of organic materials by microorganisms into inorganic materials such as carbon dioxide and water.

Molecule: The smallest particle of a substance that retains all the properties of the substance and is composed of one or more atoms.

Mutualism: A type of symbiosis where organisms from different species live in close proximity to one another, in which all organisms involved benefit from the relationship.

Natural Attenuation: Unengineered or human-influenced degradation or transformation of contaminants in an environment via naturally occurring physical, chemical, and biological processes. May include intrinsic bioremediation.

Nucleotide: A subunit of DNA or RNA consisting of a nitrogenous base, a phosphate molecule, and a sugar molecule. Thousands of nucleotides are linked to form a DNA or RNA molecule.

Nitrification: The oxidation of ammonia to nitrite and then nitrate by microorganisms. Occurs under aerobic conditions.

Obligate: Used to indicate that an environmental factor is required for growth. An obligate aerobe always requires oxygen for growth.

Organic Compounds: Chemical compounds that contain carbon and hydrogen, elements usually associated with life processes.

Oxidant: A molecule or atom that accepts electrons in an oxidation–reduction reaction.

Oxidation–Reduction Reaction: Coupled reactions in which one compound becomes oxidized (releases electrons) while another becomes reduced, gaining the electrons released.

Percolation: Gravity flow of groundwater through the pore spaces in rock or soil, usually from the unsaturated zone to the saturated zone; passing of a solvent through a permeable substance.

pH: A measure of acidity and alkalinity of a solution that is a number on a scale from 0 to 14. A value of 7 represents neutrality, lower numbers indicate increasing acidity, and higher numbers indicate increasing alkalinity. Each unit of change (e.g., from 7 to 6) represents a tenfold change in acidity or alkalinity. This change in acidity or alkalinity is the negative logarithm of the effective hydrogen-ion concentration or hydrogen-ion activity in gram equivalents per liter of the solution.

Phenotype: The observable properties of an organism; the manifestation of gene expression in that organism.

Phototroph: An organism that gets its energy from light.

Phytoremediation: Remediation influenced by eukaryotic plants.

Plasmids: a self-replicating linear or circular molecule of DNA distinct from chromosomal DNA. Some plasmids carry genes important to bioremediation.

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Plume: An elongated body of fluid, usually mobile and varying in shape. Used to define the contaminated areas of an environment.

Precipitation: The process whereby a solid settles out of a solution.

Prokaryote: One-celled microorganism whose genome is not contained within a nucleus. Comprising the two domains Bacteria and Archaea.

Protein: A large molecule composed of one or more chains of amino acids in a specific order joined by peptide bonds, containing the elements carbon, hydrogen, nitrogen, oxygen, usually sulfur, and sometimes other elements such as phosphorus and iron. Many essential biological compounds are composed of proteins, including enzymes.

Proton: Positive hydrogen ion.

Radioactivity: Spontaneous emission by radionuclides of energetic particles through the disintegration of their atomic nuclei; the rays emitted.

Radioisotope: An isotope of an element that has an unstable nucleus; it tries to stabilize itself by giving off radioactive particles and undergoes spontaneous decay.

Radionuclide: Radioisotope.

Reactant: A substance that enters into and is altered in the course of a chemical reaction.

Reaction: Here, chemical reaction — a process in which one or more substances are changed chemically into one or more different substances.

Recalcitrant: Resistant to degradation/transformation.

Redox Reaction: Oxidation–reduction reaction.

Reductant: A molecule or atom that donates an electron in an oxidation–reduction reaction.

Reduction Potential: The inherent tendency of a compound to act as an electron donor or an electron acceptor; measured in volts.

Respiration: A series of catabolic redox reactions that produce ATP, in which organic or inorganic compounds are primary electron donors and organic or inorganic compounds are terminal electron acceptors.

Rhizosphere: Soil that surrounds and is influenced by the roots of a plant.

Ribonucleic Acid (RNA): A nucleic acid containing ribose and uracil as structural components. It is found in the nucleus and cytoplasm of cells and plays an important role in protein synthesis and other chemical activities of the cell. The structure of RNA is similar to that of DNA.

Saturated Zone: An underground geologic layer in which all pores and fractures are filled with water.

Sediment: Material in suspension in water or deposited from suspension or precipitation.

Solubility: The relative capacity of a substance to serve as a solute, usually in reference to water as the solvent.

Soluble: Able to be dissolved; to pass into solution.

Solute: Any material that is dissolved in another, such as salt dissolved in water.

Solution: A homogeneous mixture of a solute in a solvent. When a solute is dissolved in a solvent, the solute molecules are separated from one another and dispersed throughout the liquid medium.

Solvent: Any material that dissolves another, such as water dissolving salt.

Sorption: The process of being taken up or held by either adsorption or absorption.

Substrate: The substance acted upon by an enzyme.

Substrate-Level Phosphorylation: Synthesis of ATP through the reaction of inorganic phosphate with an activated (usually) organic substrate. Occurs during fermentation.

Subsurface: The geologic zone below the surface of the earth.

Surfactant: A natural or synthetic chemical that promotes the wetting, solubilization, and emulsification of various types of organic chemicals. Detergents are surfactants.

Symbiosis: A type of interaction where individuals of one species live in intimate association with those of another. The main types of microbial symbiotic relationships are mutualism, commensalism, and parasitism.

Syntrophy: A form of mutualism in which the members of two species are nutritionally dependent on one another.

Transport: Conveyance of solutes and particles in flow systems.

Transuranic: Relating to or being an element with an atomic number greater than that of uranium (92).

Unsaturated Zone: An underground geologic layer in which pores and fractures are filled with a combination of air and water.

Vadose Zone: The unsaturated zone above the water table. Also known as the zone of aeration.

Valence: The property of an element that determines the number of other atoms with which an atom of the element can combine.

Volatile Organic Compounds (VOCs): Organic compounds that evaporate at room temperature.

Volatilization: Vaporization.

Water Table: The upper limit of a geologic layer wholly saturated with water.